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The Development and Use of Water Quality Objectives in Manitoba

By D. A. Williamson

Manitoba
Environment

THE DEVELOPMENT AND USE OF WATER QUALITY OBJECTIVES IN MANITOBA

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ABSTRACT

Good quality water is required for the sustained use of Manitoba's surface water resources. The Manitoba Surface Water Quality Objectives contain principles, policies, narrative objectives and numerical objectives necessary to protect this resource in Manitoba. These objectives provide the fundamental link between regulatory statutes, ambient water quality monitoring data, scientific toxicological information, water uses and public expectations. It is intended that planners, developers, industries, municipalities, and other government agencies use this information to ensure that projects are designed to avoid unacceptable impacts on water quality. Regulatory staff within the Manitoba Department of Environment subsequently use this information to assist in the development of Licences under the Manitoba Environment Act. Hence, the Manitoba Surface Water Quality Objectives are used in a pro-active manner to prevent surface water quality impacts, while still allowing development necessary for social and economic benefit. This process is consistent with emerging sustainable development strategies.

This report formed the basis for a presentation at a water quality objectives workshop, convened by the Canadian Council of Ministers of Environment, in Halifax, Nova Scotia, on September 19, 20, and 21, 1989.

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1.0 INTRODUCTION

The Manitoba Department of Environment developed a proposal detailing a system of surface water quality objectives and watershed classifications for the Province of Manitoba in 1976. The original proposal was modified slightly following widespread public review (Clean Environment Commission 1979). This system was then used to classify three major watersheds in Manitoba according to water use, namely the Souris, Red and Grass-Burntwood rivers' basins (Clean Environment Commission 1980, 1981, 1982). A number of major technical revisions were proposed for the program in 1983 (Williamson 1983a, 1983b). These proposed revisions were the subject of widespread scientific, technical and public review. The public review culminated with a two-day public hearing, held in Winnipeg during November, 1984. Several additional revisions were made subsequent to these public hearings and the revised document was released on July 31, 1988 (Williamson 1988a). Accompanying this revised Manitoba Surface Water Quality Objectives report was a rationale document describing the reasons for the latter series of revisions, including an explanation of the most controversial parts of the program, and containing the Clean Environment Commission's report on the findings of their public hearings held in 1984 (Williamson 1988b). Throughout this entire period, the Manitoba Surface Water Quality Objectives were used extensively for water quality management activities. Principal amongst these were their use by developers as a planning tool and by Manitoba Environment to assist in developing effluent discharge limitations in legally-binding licences. The Environment Act, proclaimed in Manitoba in March, 1988, provides legislative support for the Department's present role in the development and implementation of water quality objectives. Government-wide support for their development and implementation is provided in the emerging provincial water strategy (Anonymous 1989).

Other Canadian and international jurisdictions define water quality objectives in various terms. Terms such as criteria, guidelines, objectives, standards, site-adapted guidelines, site-specific guidelines, site-specific objectives, plus others are in common use. Of these various terms, only water quality standards are legally enforceable. Water quality standards are required by U.S. federal law for all state jurisdictions within the United States. All terms generally represent a sequential refinement of the initial scientific toxicological information to fit the specific circumstances at a single site. Within Manitoba, the following definition applies:

> "The Manitoba Surface Water Quality Objectives define minimum levels of quality necessary for the protection of the important water uses in Manitoba. The objectives, when not exceeded, will protect an organism, a community of organisms, or other designated multiple-purpose water uses."

Thus, the Manitoba Surface Water Quality Objectives are analogous to the Canadian Water Quality Guidelines [Canadian Council of Resource and Environment Ministers (CCREM) 1987], with the exception that they have been site-adapted for general use in Manitoba.

A summary of this program and its use in Manitoba is described in the following sections. The general process, from the initial scientific research through to the actual use of water quality objectives in Manitoba water quality management activities, is illustrated in Figure 1. The corresponding affiliations with each of these processes are indicated at the bottom of the figure.

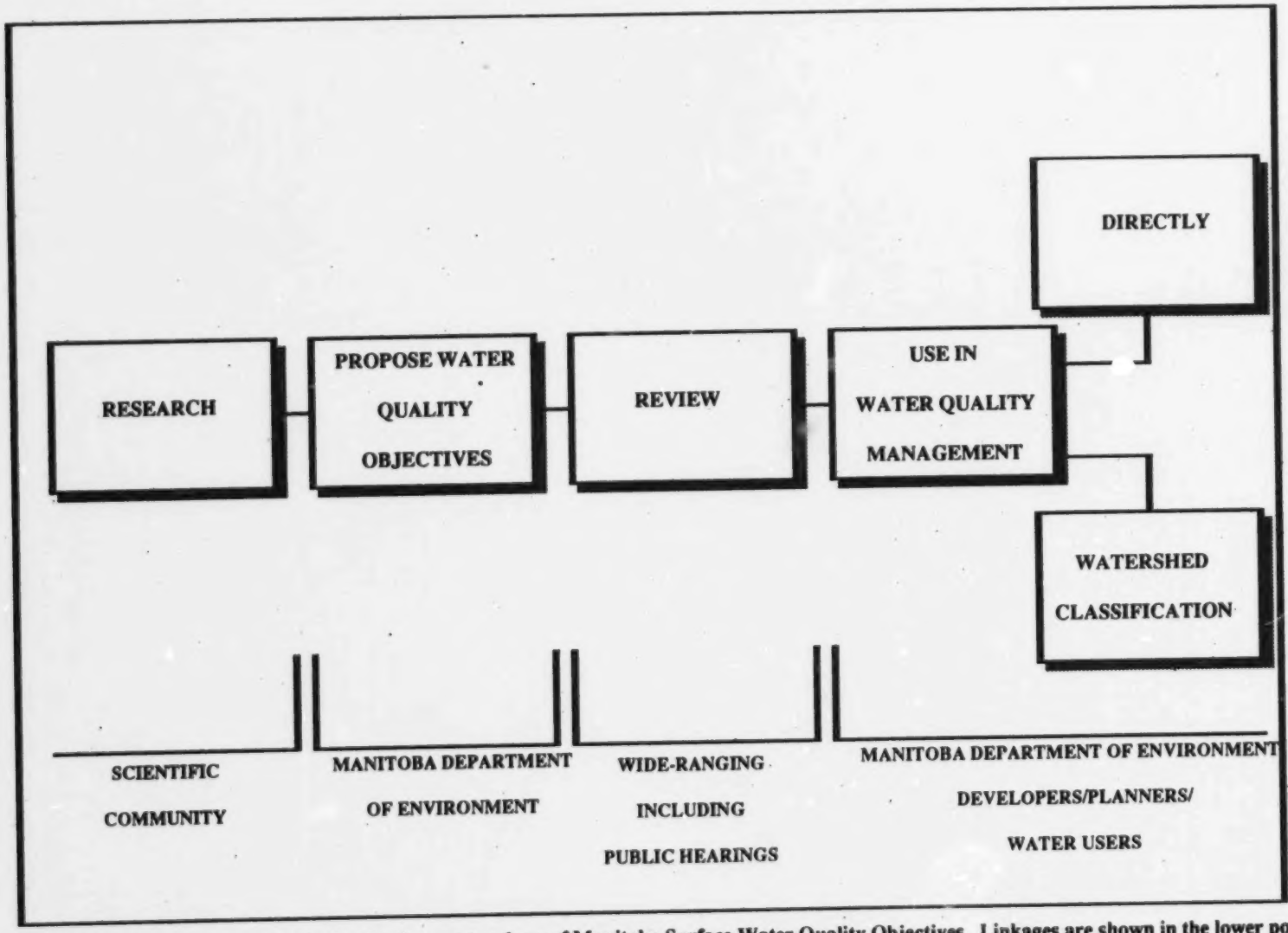

Figure 1: General process used in the development and use of Manitoba Surface Water Quality Objectives. Linkages are shown in the lower portion of the figure.

2.0 SCIENTIFIC RESEARCH

Scientific research on cause-effect relationships between concentrations of a toxic material and aquatic organisms, environmental transport phenomena, and fate within the aquatic ecosystem forms the basis for all credible water quality objectives. Primary research is conducted by scientists throughout the world, with information being available through scientific journals. In most cases, problems encountered in other jurisdictions are similar either to those existing at present or to those that could potentially exist in the future within Manitoba. Thus, with few exceptions, the world scientific toxicological data base is generally suitable for meeting the information needs of Manitoba. Therefore, Manitoba Environment rarely conducts primary scientific research in this area, but relies upon information produced by other research agencies.

3.0 DEVELOPMENT OF WATER QUALITY OBJECTIVES

Manitoba Environment does not directly develop objectives for the various materials of concern from the primary scientific literature. Rather, criteria, guidelines, objectives or standards from other jurisdictions are thoroughly evaluated for their applicability to Manitoba, then adopted if appropriate. In a number of cases, the information has been modified to better suit the unique conditions within Manitoba. This method is efficient in terms of utilizing limited financial and human resources.

Water quality objectives (or criteria, guidelines, etc.) have been developed for numerous variables from basic research using systematic methods by a number of jurisdictions and agencies [U.S. EPA 1985, CCREM 1987, CCME 1989, Ontario Ministry of Environment 1989, European Inland Fisheries Advisory Commission (Alabaster and Lloyd, 1982), Health and Welfare Canada 1987, plus others]. Such systematic methods differ somewhat between agencies, depending upon philosophical and scientific approaches related to the degree of protection desired within each jurisdiction and the desired level of confidence required in the data base. Manitoba Environment (Williamson 1988a) has selected the methods used by the U.S. EPA (1985) for the protection of aquatic life and wildlife for those variables with a large existing toxicological data base. Objectives for other variables are selected from other jurisdictions when the U.S. EPA (1985) minimum data base requirements cannot be satisfied. Thus, Manitoba Environment has adopted the philosophy of preventing the occurrence of <u>unacceptable</u> levels of impairment, as opposed to preventing the occurrence of <u>all observed responses</u>, at least for routine application in the developed regions of Manitoba (Williamson 1988b).

4.0 MANITOBA SURFACE WATER QUALITY OBJECTIVES

Manitoba Surface Water Quality Objectives are in two principal forms, namely general or narrative surface water quality objectives and specific or numerical surface water quality objectives. Additionally, guidance is provided through a number of policies that assist in the implementation and interpretation of these objectives in water quality management activities. Each of these three areas are described in the following sections.

4.1 Narrative Surface Water Quality Objectives

Narrative surface water quality objectives are general statements that attempt to describe conditions within Manitoba's aquatic systems that should be avoided. While such narrative statements are of less practical value than are

specific numerical surface water quality objectives, the lack of scientific information precludes the development of more specific objectives at the present time. These narrative surface water quality objectives provide statements of intent, that can be used to protect water quality. Such narrative statements have been developed for colour, odour, taste, turbidity, floating materials, oil and grease, deposits on bottom sediments or shorelines, nutrients, toxic substances, litter, and flow. For example, the narrative surface water quality objective for oil and grease is as follows:

> "Free from oil and grease residues which causes a visible film or sheen upon the waters or any discolouration of the surface of adjoining shorelines or causes a sludge or emulsion to be deposited beneath the surface of the water or upon the adjoining shorelines."

4.2 Numerical Surface Water Quality Objectives

Numerical surface water quality objectives have been adopted from other jurisdictions and in some cases have been site-adapted for use in Manitoba. Such objectives are included for over 80 variables. The numerical surface water quality objectives are arranged according to the important water uses within Manitoba. These uses are similar to those described by other jurisdictions (cf. CCREM 1987, Saskatchewan Environment and Public Safety 1988). Manitoba's numerical surface water quality objectives are arranged to protect the following uses:

Class 1: Domestic Consumption: Numerical surface water quality objectives will protect the use of raw water supplies for domestic consumption, culinary, food processing or other household purposes. Inherent in these objectives is the necessity to disinfect all raw surface water supplies prior to use as a minimum level of treatment.

Class 2: Aquatic Life and Wildlife: The numerical surface water quality objectives within this class will ensure the protection of waters that are inhabited by aquatic life such as fish, amphibians, reptiles, and other forms of life including aquatic insects and algae. By ensuring protection of the aquatic communities, protection is indirectly offered to those forms of wildlife that rely upon surface waters for habitat and for food supplies. These include ducks, geese, fur-bearing mammals such as the muskrat and birds of prey such as the eagle and osprey. Protection is also provided to those animals that use these waters for drinking purposes.

This class is divided into two categories in order to provide protection to the two general types of aquatic life communities within Manitoba. The first category will provide protection to all types of aquatic life in Manitoba including wildlife that rely upon surface waters for habitat or for a source of food supplies. This includes both "cold-water" and "cool-water" types of aquatic life communities. The second category will only provide protection to "cool-water" types of aquatic life communities, as well as wildlife.

Class 3: Industrial Consumption: Objectives within this class will protect the quality of raw water sources used for industrial purposes. However, because the various general types of industries have unique water quality requirements, numerical objectives have not

yet been adopted for this class. Rather, the unique requirements of industries are considered on a site-specific basis during assessments and licencing of upstream dischargers. Generally, guidelines for industrial water quality, developed by the CCREM (1987) are used for this purpose.

Class 4: Agricultural Consumption: This class is divided into four categories, three of which are intended to protect the quality of surface water used for three general types of irrigation. These include the irrigation of greenhouse plants, plus two types of field crop irrigation. The fourth category is intended to protect the quality of water used for livestock watering.

Class 5: Recreation: This class is divided into two categories in order to provide protection for the quality of water used for two general types of aquatic recreation. The objectives within the PRIMARY RECREATION category are intended to protect surface water used for activities in which the entire body may become completely immersed. The objectives within the SECONDARY RECREATION category will protect the quality of water used for other water activities, such as boating, where there is considerably less probability that the entire body would become completely immersed.

Class 6: Other Uses: This class is set aside for those surface water uses that require protection but are not well defined within the preceding classes or categories. Additionally, certain waters, for example, may be set aside for incorporation into industrial treatment processes. Such waters, therefore, may not require protection of water quality.

A brief example of the numerical surface water quality objectives is shown in Table 1.

Table 1: Numerical surface water quality objectives for five common variables for the protection of water uses in Manitoba. Additional categories are listed in the Manitoba Surface Water Quality Objectives but are not illustrated in this example.

VARIABLE	DOMESTIC CONSUMPTION	AQUATIC LIFE AND WILDLIFE	AQUATIC LIFE AND WILDLIFE	GREENHOUSE IRRIGATION	FIELD CROP IRRIGATION	LIVESTOCK WATERING	PRIMARY RECREATION	SECONDARY RECREATION
Fecal Coliform	10/100 mL	No Obj.	No Obj.	1000/100 mL	1000/100 mL	No Obj.	200/100 mL	1000/100 mL
Sodium	400.0 mg/L	No Obj.	No Obj.	4.0 SAR	6.0 SAR	No Obj.	No Obj.	No Obj.
Boron	5.0 mg/L	No Obj.	No Obj.	0.5 mg/L	1.0 mg/L	5.0 mg/L	No Obj.	No Obj.
Dissolved Oxygen	No Obj.	60% Sat.	47% Sat.	No Obj.	No Obj.	No Obj.	Aerobic	Aerobic
Zinc	5.0 mg/L	0.047 mg/L	0.047 mg/L	2.0 mg/L	10.0 mg/L	50.0 mg/L	No Obj.	No Obj.

4.3 Implementation Policies

4.3.1 Limitations and Modifications, Mixing Zones, and Low Flow Conditions

Information is provided in Williamson (1988a) to assist in the application of the Manitoba Surface Water Quality Objectives at specific sites. This information is in the form of a number of policies or guidelines concerning limitations of the objectives, how and under what general circumstances modifications can be made to the objectives, how the objectives should apply to point-source discharges within the area of initial effluent mixing, and how the objectives apply to extremely low river and stream flows.

With regard to mixing zones, it is recognized that it is not reasonable in many circumstances to expect the numerical surface water quality objectives to be met at the distal end of the discharge pipe. Therefore, a zone of initial dilution is necessary in which some numerical objectives may not be met. Therefore, guidelines were developed to limit the nature and extent of adverse conditions within this zone. The following are several examples:

> "the mixing zone should be designed to allow an adequate zone of passage for the movement or drift of all stages of aquatic life,
>
> (i). for those materials that elicit an avoidance response from aquatic life, the mixing zone should contain not more than 25% of the cross-sectional area or volume of flow at any transect in the receiving water. Should a proportion of the stream width greater than 25% be selected for these materials, the mixing zone could act similar to a physical barrier and could effectively preclude the passage of aquatic life,
>
> (ii). the mixing zone should not be acutely lethal to aquatic life passing through the mixing zone. Thus, acute lethality within the mixing zone is a function of the concentration of a toxic material and the duration of exposure,
>
> (iii). mixing zones should not interfere with the migratory routes essential to the reproduction, growth or survival of aquatic species,
>
> (iv). mixing zones should not cause an irreversible organism response, or increase the vulnerability to predation,
>
> (v). when two or more mixing zones are in close proximity, they should be so defined that a continuous passageway for aquatic life is available,
>
> (vi). mixing zones should not intersect the mouths' of rivers,"

It is generally recognized that it is not practicable for dischargers to comply with the numerical surface water quality objectives under all possible low-flow situations on specific rivers or streams. Thus, a policy was developed which requires that the objectives must be met at all river and stream flows above the average minimum seven day flow which occurs once in ten years (Q_{7-10}).

Exceptions include cases where the flow is less than this volume but important water uses are still maintained by the effect of ponding. Intermittent streams which flow for a short period during most years, have a Q_{7-10} of 0.0 m^3/s. Since the Q_{7-10} is of little practical value in these cases, a policy was developed that requires the numerical surface water quality objectives to be met on intermittent streams at all flows above 0.003 m^3/s.

4.3.1 Levels of Protection

The Manitoba Surface Water Quality Objectives offer options for four different levels of protection to specific aquatic systems. These are as follows:

NO PROTECTION: Circumstances at limited sites may determine that a specific body of water should not be afforded protection, or an individual water use within that body of water should not be afforded protection. These are legitimate decisions that can be made by water quality managers, based upon scientific, social or economic constraints. For example, a small lake or marsh may become incorporated into the wastewater treatment system at an industrial processing site. Hence, such a body of water would not be afforded protection.

ROUTINE: The routine level of protection within Manitoba is a combination of firstly, the application of Best Available Technology Economically Achievable (BATEA), more commonly known in Canada as Best Practicable Technology (BPT), and secondly, the application of the Manitoba Surface Water Quality Objectives in cases where water uses are not adequately protected by the sole use of BATEA or BPT. This ensures that all pollutants are reduced or eliminated with the use of standard treatment technologies commonly available to each unique industry. It also recognizes that in other cases, the sole use of common, technology-based treatment systems may not provide protection to a specific body of water (e.g. large volume of discharge to a small stream, a number of industries discharging to a single body of water, etc.). In these cases, surface water quality objectives are used to develop effluent limitations that will provide the required protection. The effluent limitations are developed such that the surface water quality objectives will not be exceeded.

HIGH QUALITY DESIGNATION: A major limitation associated with the above mentioned routine level of protection is that all bodies of water are considered equal in value (intrinsic, economic and social) and that some magnitude of change is acceptable. Ultimately, the change could be greater than that expected, thus resulting in an adverse impact. The routine method also places little emphasis upon maintaining the existing quality of a body of water. Therefore, the HIGH QUALITY DESIGNATION can be used to place greater restrictions upon development within certain pristine or near-pristine areas of Manitoba.

The HIGH QUALITY DESIGNATION recognizes that some development has already occurred within the region in question or that future development may be probable. Despite this, it is desirable to place greater environmental restrictions on new or expanded developments. The water bodies within these areas must

meet certain requirements in order to be considered for this designation. These include the following:

(a). waters that flow through or that are bounded by Provincial or National Parks,
(b). waters within relatively undisturbed watersheds,
(c). waters possessing outstanding quality characteristics,
(d). waters that support a diverse or unique flora and fauna which are sensitive to man-induced water quality alterations,
(e). waters designated as Canadian Heritage Rivers.

The greater restrictions placed upon developments within HIGH QUALITY areas include firstly, an additional degree of justification of the proposed new, additional or increased discharges in terms of the social and economic benefits to the local, regional or Manitoban economies. Secondly, should the proposed development be of significant benefit and alternatives not be available in other nearby regions, then a combination of Best Available Technology, land disposal, re-use and discharge technologies will be used. Thus, developers can anticipate much higher costs associated with environmental control within areas designated as HIGH QUALITY.

This designation will ensure that the risk of altering water quality will be maintained at zero or as close to zero as possible, but it also recognizes that some development has already occurred, and that in future other developments might similarly be considered. The designation does not prohibit all such developments, but requires that they satisfy certain stringent criteria.

Water bodies are designated as HIGH QUALITY through the WATERSHED CLASSIFICATION process discussed in a subsequent section. At present, over 10,000 km^2 of Manitoba have been designated as HIGH QUALITY.

EXCEPTIONAL VALUE DESIGNATION: This designation provides the fourth and highest level of water quality protection within Manitoba. Water courses designated as such will not receive "any alterations that result in measurable, calculable or perceived water quality degradation or degradation of other values deemed exceptional" (Williamson 1988a). Waters considered for this designation are as follows:

(a). Ecological Reserves,
(b). wild and scenic rivers or lakes,
(c). waters or watersheds providing habitat for rare or endangered flora and fauna,
(d). waters considered sensitive such that irreversible harm will result following human impact,
(e). waters whose exceptional quality and value as a future resource precludes the assignment of present uses,
(f). waters designated as Canadian Heritage Rivers.

Water bodies designated as EXCEPTIONAL VALUE, will be essentially removed from the potential for development, thus

eliminating the risk of water quality change due to man's local influence. The EXCEPTIONAL VALUE designation will be applied through the WATERSHED CLASSIFICATION process. At present, no such water bodies have been designated as EXCEPTIONAL VALUE, although a number of potential candidates exist in remote northern and eastern areas of Manitoba.

5.0 SCIENTIFIC, TECHNICAL AND PUBLIC REVIEW

A large scientific, technical and public review component is involved in the Manitoba Surface Water Quality Objectives. Initially, recommendations concerning the objectives are made by staff within Manitoba Environment, then are circulated for review and comment to a standing committee comprised of representatives from numerous other Manitoba government departments. At present, the Interdepartmental Committee on Manitoba Surface Water Quality Objectives consists of 13 members from other Manitoba government agencies. This participation ensures that the objectives reflect a wide perspective within the Manitoba provincial government. The objectives are then circulated to a large number of outside agencies representing research scientists, environmental groups, specific industries and municipalities, industrial and municipal associations, and other Canadian jurisdictions. Additionally, copies are forwarded to the Clean Environment Commission, to ensure that widespread public involvement is obtained. The Clean Environment Commission, appointed by Cabinet and chaired by a full-time civil servant, solicits input from the public and provides independent advice to the Minister, as provided for in the Manitoba Environment Act. If the Clean Environment Commission or Manitoba Environment deems it necessary, public hearings are held. The Clean Environment Commission held public hearings on the original surface water quality objectives proposal during the late 1970's and held public hearings on a major series of revisions in 1984.

6.0 USE OF MANITOBA SURFACE WATER QUALITY OBJECTIVES IN WATER QUALITY MANAGEMENT ACTIVITIES

The Manitoba Surface Water Quality Objectives are used for the following purposes:

(a). **AS A PLANNING TOOL:** Using the Manitoba Surface Water Quality Objectives, developers can make informed decisions with regard to the type and cost of environmental control required at the preferred site in comparison to others. This information can be used very early in project planning, just as information on transportation costs, availability of land and its costs, work-force costs, and other important factors must be considered. Potential developers can therefore quite accurately estimate the environmental control costs associated with any proposed location.

(b). **TO DEVELOP EFFLUENT DISCHARGE LIMITS:** Virtually all projects that have the potential to impair the environment must be licenced under the Manitoba Environment Act. For example, in cases where the ROUTINE level of protection is being provided, as described above, Manitoba Department of Environment uses the surface water quality objectives to limit the discharge of materials not sufficiently controlled by the use of Best Available Technology Economically Available-based treatment systems. The general factors that must be considered are shown in Figure 2. A thorough assessment is conducted of the proposed facility, including the identification of all potential pollutants and their expected concentration or discharge load. The assessment will then address the following:

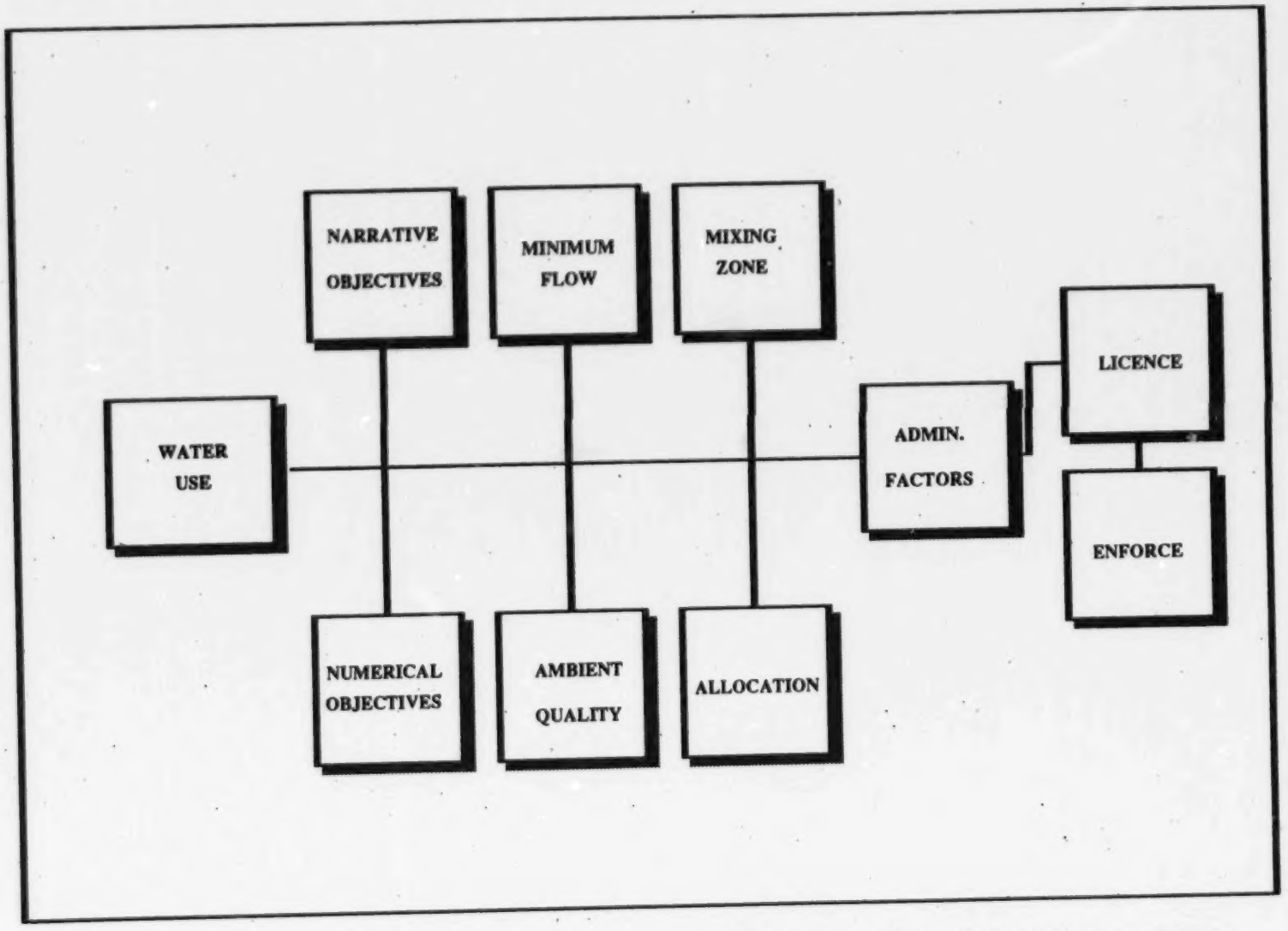

Figure 2: Process diagram showing the information required to derive effluent discharge limitations from the Manitoba Surface Water Quality Objectives.

(i). identification of the downstream water uses,
(ii). the narrative and numerical surface water quality objectives for the identified pollutant necessary in order to protect the downstream water uses,
(iii). the minimum stream flow (Q_{7-10}),
(iv). delineation of a mixing zone for the pollutant in question. Should the material cause an avoidance response, an un-obstructed pollutant-free passage within the stream will be maintained.
(v). allocation of the available dilution or assimilative capacity for the proposal. A proportion of the assimilative capacity may be left un-allocated for either future expansion or for future downstream developments.

Maximum allowable loadings or concentrations are then computed using commonly accepted models. Most frequently, such models are simple algorithms based upon conservation of mass, without consideration of transformation or partitioning within the receiving body of water. In some cases, the result may be modified slightly in order to incorporate the information into a legally-enforceable licence.

This process is further described in the brief example shown in Figure 3. Springhill Farms Ltd., a large hog abbatoir, is located near the Town of Neepawa, in the south-central region of Manitoba [for general reference, this area is located near the southern-most region of the Dauphin River Watershed (Watershed #5) on Figure 5]. Liquid effluent discharges are directed towards the Whitemud River, a relatively small stream that eventually empties into Lake Manitoba. The stream is used as a source of water for domestic consumption, irrigation, livestock watering, recreation and habitat for native cool water and stocked cold water species of fish. Water flow in this stream is regulated by a control structure at the outlet of Lake Irwin. The Town of Neepawa also discharges treated municipal sewage twice annually, from a multi-celled lagoon, to the Whitemud River immediately upstream from Springhill Farms Ltd.

A preliminary environmental assessment identified un-ionized ammonia discharges from the development as a potential concern. During a detailed assessment, monthly limitations were calculated for un-ionized ammonia. The information that formed the basis of the limitations for the month of July is as follows (please note that while this is an actual example, the information considered during the assessment is much too lengthy to be adequately documented here):

Minimum stream discharge	= 17122 m^3/day (secured by the proponent through a Water Rights Licence)
Average July pH	= 8.04
Average July water temperature	= 17.9°C
Average upstream un-ionized ammonia	= 0.0006 mg/L
Predicted volume of effluent discharge	= 357 m^3/day

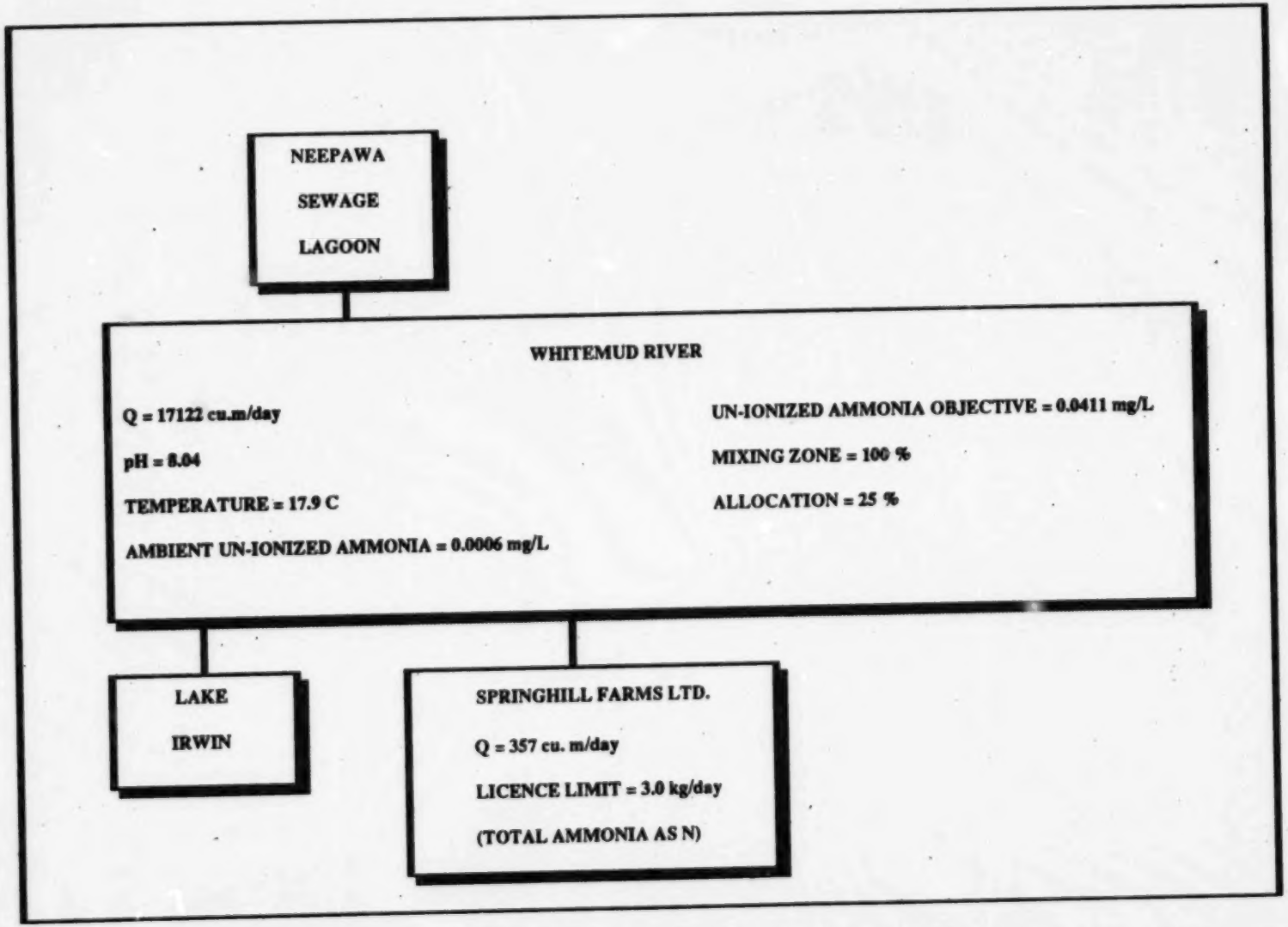

Figure 3: Actual example illustrating the use of the Manitoba Surface Water Quality Objectives to derive effluent discharge limitations for un-ionized ammonia at Springhill Farms Ltd. for the month of July.

Manitoba Surface Water Quality Objective for un-ionized ammonia at 17.9°C and 8.04 pH units	= 0.0411 mg/L
Mixing zone	= 100% of stream width or volume of flow
Allocation of assimilative capacity	= 25% of volume of flow
Limitation in Licence 1103VC	= 3.0 kg/day, total ammonia as N (calculated using conservation of mass algorithm after appropriate conversions between un-ionized ammonia and total ammonia using accepted equilibrium equations)

(c). **TO DEVELOP LAND MANAGEMENT PRACTICES:** While more technically difficult than the use of the objectives to develop effluent discharge limitations, it is possible to develop land management plans aimed at reducing diffuse sources of pollutants to water bodies.

(d). **TO INTERPRET WATER QUALITY DATA:** Ambient water quality data can be compared directly to the objectives to identify exceedences or long-term trends that may lead to exceedences in the future. Management intervention can then be undertaken.

(e). **TO ASSESS CONTROL EFFECTIVENESS:** The surface water quality objectives can be used to determine whether or not effluent limitations are effective in ensuring that downstream objectives are not exceeded.

(f). **TO DETERMINE WHETHER SPECIFIC WATERS ARE SUITABLE FOR CERTAIN USES:** The surface water quality objectives, in combination with ambient monitoring data, can be used to initially determine whether or not specific bodies of water are suitable for certain proposed uses or activities.

7.0 WATERSHED CLASSIFICATION

The Manitoba Surface Water Quality Objectives can be used directly as discussed in the previous section, or they can be used to develop long-term water quality management plans, through WATERSHED CLASSIFICATION. WATERSHED CLASSIFICATION is an administrative and planning process whereby surface water quality objectives are applied to individual streams, lakes, or entire watersheds in order to protect multiple water uses. The surface water quality objectives may be modified, where appropriate, to better reflect the unique circumstances within the area under consideration. Modifications can be undertaken to account for the lower or greater sensitivity of resident aquatic species, to consider the altered availability or toxicity of a pollutant due to chemical or physical properties of the receiving water, or other reasons. Reasonable scientific evidence, professional judgement, or other evidence must be used to ensure that surface water uses at specific sites will not be unacceptably impaired following such modifications. WATERSHED CLASSIFICATION is a complex process and is outlined in Figure 4.

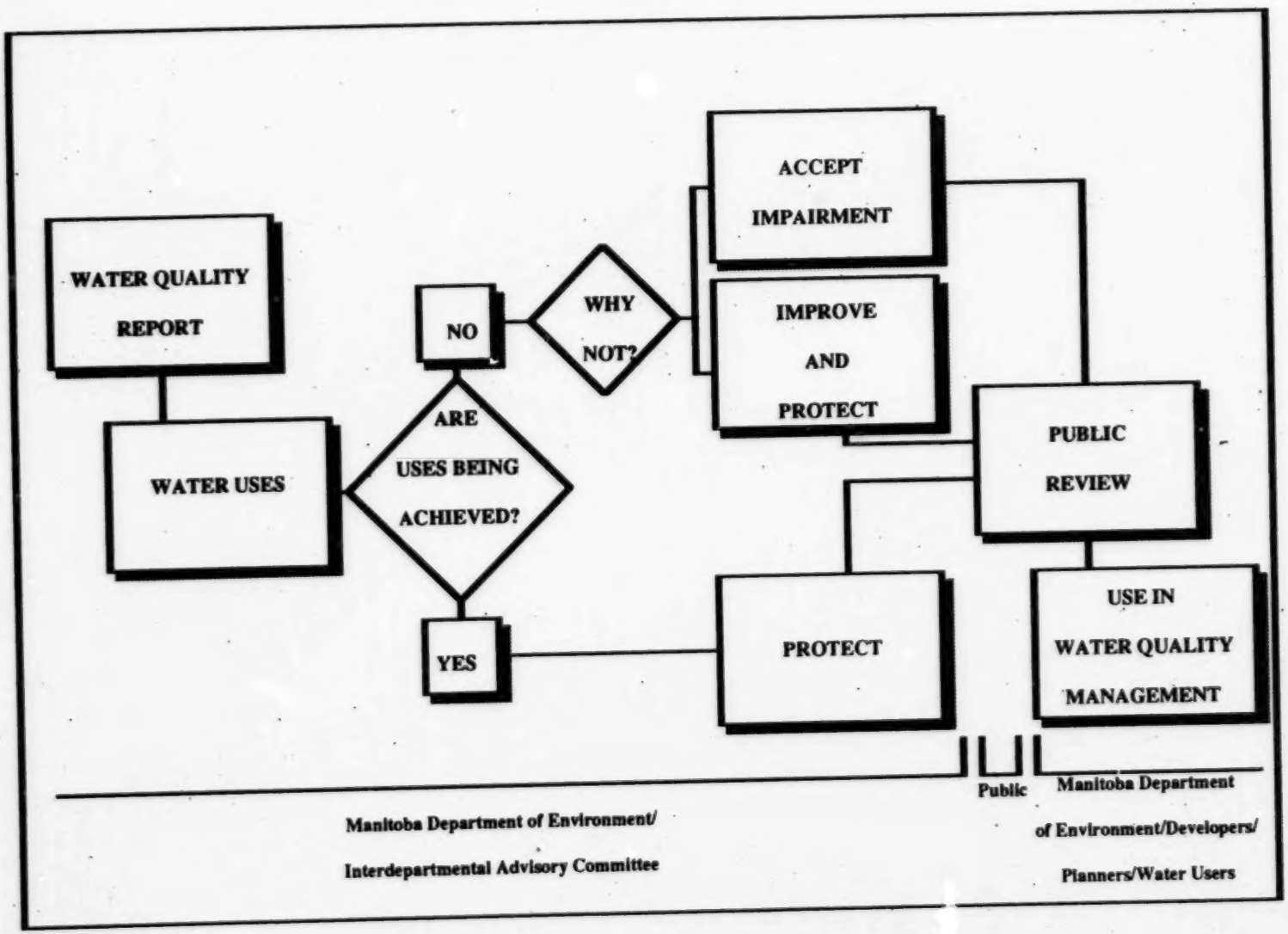

Figure 4: Diagram illustrating the WATERSHED CLASSIFICATION process within Manitoba.

A water quality report is prepared that consists of an assessment of existing conditions, identification of existing and potential future water uses, and determination of whether or not water quality may be a limiting factor in achieving the present or future uses. If water quality is not a limiting factor, then water quality objectives are recommended to protect the identified uses. An appropriate level of protection (e.g. ROUTINE, HIGH QUALITY, or EXCEPTIONAL VALUE) is also recommended during this stage of the process. However, if the existing water quality is presently impaired, thus affecting either a present or future water use, further evaluation is necessary. This additional evaluation is guided by the following general questions:

(1). Which water uses are being impaired?
(2). What are the water quality variables causing the impaired use?
(3). To what extent do human activities contribute to the impairment?
(4). What level of control is required to ameliorate the water quality exceedences?
(5). Do control technologies actually exist in order to achieve the level of reclamation necessary?
(6). Does the cost of achieving the water quality improvement bear a reasonable relationship to the benefits associated with attaining the water use?

Depending upon the result of this evaluation, surface water quality objectives could be recommended for the site under consideration such that the existing impaired water quality would be accepted. Alternately, objectives could be recommended that would provide the basis for a plan that would improve water quality to the level necessary to protect the presently affected water use.

Following the preparation of the WATERSHED CLASSIFICATION proposal, it is subject to wide-ranging technical, scientific and public review, including public hearings conducted by the Clean Environment Commission. This review is similar to that discussed in the preceding section entitled SCIENTIFIC, TECHNICAL AND PUBLIC REVIEW. Following endorsement of the finalized proposal by government, the surface water quality objectives that are refined and established through the WATERSHED CLASSIFICATION process, are used as the basis for managing water quality, as identified in the preceding section entitled USE OF MANITOBA SURFACE WATER QUALITY OBJECTIVES IN WATER QUALITY MANAGEMENT ACTIVITIES.

WATERSHED CLASSIFICATION offers a number of advantages in comparison to direct use of the surface water quality objectives. Principal amongst these is the ability to develop a rational, long-term, water quality plan for a region, in a public process that encourages wide-ranging debate on beneficial water uses, costs, benefits, etc.

The Province of Manitoba has been divided into nineteen watersheds (Figure 5). At present, only the Souris (7), Red (8), Grass-Burntwood (12) and part of the Saskatchewan (4) rivers watersheds have been classified.

8.0 CONCLUDING REMARKS

The Manitoba Surface Water Quality Objectives provide the principal foundation for protection and management of water quality within Manitoba. It is essential that the program continue to evolve in order to incorporate new scientific findings related to specific chemicals, emerging ecological principals related to protecting aquatic ecosystems, as well as innovative administrative procedures in order to effectively use the objectives for their intended purpose.

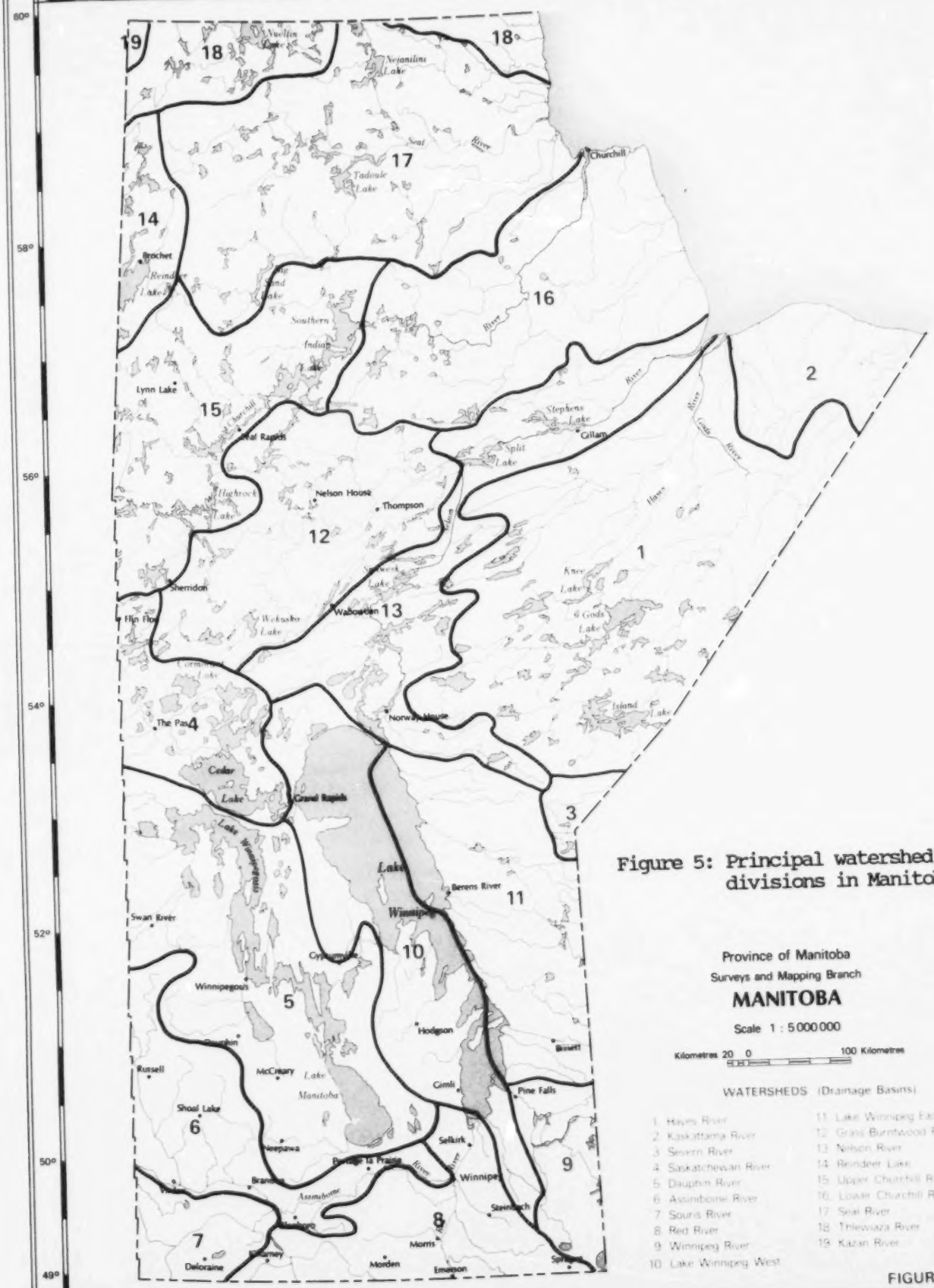

Figure 5: Principal watershed divisions in Manitoba.

FIGURE 1

9.0 REFERENCES

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